

Environmental Enrichment of Calves Using Stationary and Mechanical Brushes

Honors Research Thesis

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Jaime E. Uren

Department of Animal Sciences

The Ohio State University

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Project Advisor: Dr. Maurice L. Eastridge, Department of Animal Sciences
The Ohio State University

ABSTRACT

While there is research on enrichment and brush use in adult cows, there is limited research addressing brush use in calves. The objectives were to substantiate brushes as enrichment devices for calves and determine if exposure to stationary brushes pre-weaning affects brush use post-weaning. Calves were randomly grouped into treatment group B (with brush, $n = 10$) or treatment group N (no brush, $n = 10$). During pre-weaning, calves were housed individually in hutches from birth until at least 8 weeks of age, and group B had access to stationary brushes. During post-weaning, calves entered group housing and had access to a mechanical and stationary brush until at least 11 weeks of age. Physical performance characteristics were recorded throughout the trial, and behavior was recorded using video cameras for 12 h/d twice a week. During pre-weaning, treatments had similar ADG (0.610 kg/d), weight (41.8 kg), hip height (75.8 cm), and wither height (72.4 cm). During post-weaning, treatments had similar ADG (0.747 kg/day), changes in hip height (0.212 cm/day), and changes in wither height (0.204 cm/day). This suggests exposure to stationary brushes pre-weaning did not affect growth. In preliminary analysis for 16 calves pre-weaning, group B ($n = 8$) used stationary brushes for 133.8 s/12 hr, demonstrating that calves utilized stationary brushes as enrichment tools during pre-weaning. The treatments spent similar durations interacting with pen fixtures pre-weaning (434.9 vs. 419.0 ± 98.41 s/12 hr for B and N respectively). In preliminary analysis of 11 calves post-weaning, there was a treatment by week trend for mechanical brush use, indicating that calves exposed to brushes pre-weaning used the mechanical brush quicker post-weaning. The use of the stationary brush post-weaning was minimal, thus we conclude calves preferred the mechanical brush. We expect further analysis to show behavioral differences between treatments, indicating that exposure to a brush pre-weaning affects behavior post-weaning.

INTRODUCTION

Dairy calf welfare is an important subject in the field of animal science today. As consumers become increasingly concerned with animal welfare, producers are recognizing the need for improved management techniques on farm. There is current research about rotating, mechanical brush use in adult cows, as well as widespread use (Wilson, 2002; DeVries, 2007; Mandel, 2013). However, there is limited research and in-field use of such brushes for calves. Therefore, research providing evidence to whether mechanical brushes are valuable enrichment devices for dairy calves will give producers legitimate options for improving dairy calf welfare.

Wilson et. al. (2002) demonstrated that enrichment tools for scratching purposes were used most among items studied and had sustained interest for feedlot cattle. Also, duration and frequency of grooming behaviors increased (by 508% and 206 % respectively) after dairy cattle were exposed to a mechanical brush, indicating that mechanical brushes may facilitate grooming activity in dairy cows (DeVries et. al., 2007). Mandel et. al. (2013) suggested that analysis of cow behavior around a mechanical brush could be used as a gauge of well-being since use of the brush declined during periods of decreased energy (e.g., food placed far away or post artificial insemination). In the limited research addressing dairy calf enrichment, Pempek et. al. (2017) found that calves used lollies, artificial teats, rubber chain links, and stationary brushes as enrichment tools, and the stationary brushes were used most among those items. Finally, research has provided evidence that calves housed in pairs utilized both manila ropes and mechanical brushes for 27.1 min/d (Zobel et. al., 2017). These studies encourage additional research regarding the enrichment of dairy calves using stationary and mechanical brushes. The purpose of the project was to provide evidence to the value of brushes as enrichment devices for dairy calves.

The objectives of the study were to:

1. Substantiate the use of stationary and mechanical brushes as enrichment devices for dairy calves.
2. Determine if dairy calf exposure to stationary brushes during pre-weaning affects the use of mechanical and stationary brushes during post-weaning.

The hypotheses of the study were:

1. Stationary and mechanical brushes are beneficial environmental enrichment tools for dairy calves.
2. Compared to dairy calves with no brush exposure during pre-weaning, dairy calves exposed to a stationary brush during pre-weaning would spend more time using the mechanical and stationary brushes during post-weaning.

MATERIALS AND METHODS

The project took place at The Ohio State University's Waterman Dairy Center in Columbus, OH from May 2017 through October 2017 and in accordance to the guidelines set by the Institutional Animal Care and Use Committee (Animal Use Protocol 2017A00000016). Twenty Jersey calves were randomly assigned into either treatment group B (with stationary brush, n = 10 calves) or treatment group N (no stationary brush, n = 10 calves). Calves were blocked by date of birth and birth weight.

Housing

During the pre-weaning period, calves were housed individually in hutches with wire pen enclosures until at least 8 weeks of age, and only group B had access to a stationary brush (Figure 1a).

During the post-weaning period, all calves were moved into group housing until at least 11 weeks of age and had access to both a stationary brush and a rotating, mechanical brush (DeLaval Mini Swinging Brush MSB) (Figure 1b).



Figure 1a. The design for the individual hutches for calves with a brush (B). Hutches for calves without a brush (N) were identical except there was no stationary brush attached to the pen.

Figure 1b. The design for the group housing enclosure. The pen contained a rotating, mechanical brush (1) and a stationary brush (2).

Feeding

During the pre-weaning period, calves had unrestricted access to water and a texturized starter grain. Calves were fed milk replacer 2x/d by bucket (2.2 L/feeding for the first 2 weeks and 2.6 L/feeding after that). At week 7, calves were reduced to only one milk feeding per day (2.6 L/feeding). Calves were fully weaned by 8 weeks. Calves remained in the hutches for at least one week after they were weaned before moving to group housing.

During the post-weaning period, calves had unrestricted access to water and were fed a restricted amount (1.1 kg/head/feeding) of a sweet feed 2x/d for the first week, a 50/50 mix of the sweet feed and a pelleted grain 2x/d for the second week, and the pelleted grain 2x/d beginning on the third week and then until the completion of the study.

Behavior

Calf behavior was recorded on video cameras for 12 h/d twice a week.

The behaviors that were recorded during the pre-weaning period are in Table 1.

Table 1. Ethogram of the behaviors recorded during the pre-weaning period

Behavior	Description
Locomotive play	The calf is moving in the pen in a playful manner by either bucking, galloping, or leaping into and out of the hutch.
Interaction with pen fixtures	The calf is outside of the hutch and is interacting with the brush (but not for scratching or grooming purposes) or interacting with other pen fixtures (including biting, sucking, licking, rubbing, and scratching).
Self-grooming	The calf is outside of the hutch and is using its tongue to touch and groom its body.
Stationary brush use	The calf is using the brush for scratching or grooming purposes.
Other	The calf is performing a behavior that is not listed on the table or is not clearly identified by the observer.
No visual	The view of the calf is blocked or obscured.

During the post-weaning period, each calf was distinguished by a marking on its back. The behaviors that were recorded are in Table 2.

Table 2. Ethogram for behaviors recorded during the post-weaning period

Behavior	Description
Mechanical brush use	The calf is using the mechanical brush for scratching or grooming purposes.
Stationary brush use	The calf is using the stationary brush for scratching or grooming purposes.
Other	The calf is performing a behavior that is not listed on the table or is not clearly identified by the observer.

Physical Performance

Throughout the pre-weaning period, calf weight was recorded once a week. Hip height and wither height were recorded once every 3 weeks.

During the post-weaning period, calf weight, hip height, and wither height were recorded directly before calves entered group housing and at the conclusion of the trial.

Statistical Analysis

Behavior was assessed by two observers from recorded video footage using Noldus Observer XT 12 (Wageningen, The Netherlands). The observers demonstrated over 99% inter-observer reliability on 3 training videos at the beginning of the analysis process. All data were analyzed using SAS with $P < 0.05$ indicating statistical significance and $0.05 < P < 0.10$ indicating a trend.

RESULTS

Physical Performance

Calf growth during the pre-weaning period was similar for calves with a brush (B) and without a brush (N). There were no differences between treatments during the pre-weaning period in body weight (BW), average daily gain (ADG), hip height, and wither height (Figure 2; Table 3). Calf growth was also similar during post-weaning for calves with a brush (B) and without a brush (N). There were no differences between treatments during the post-weaning period in ADG, change in hip height, or change in wither height (Table 3).

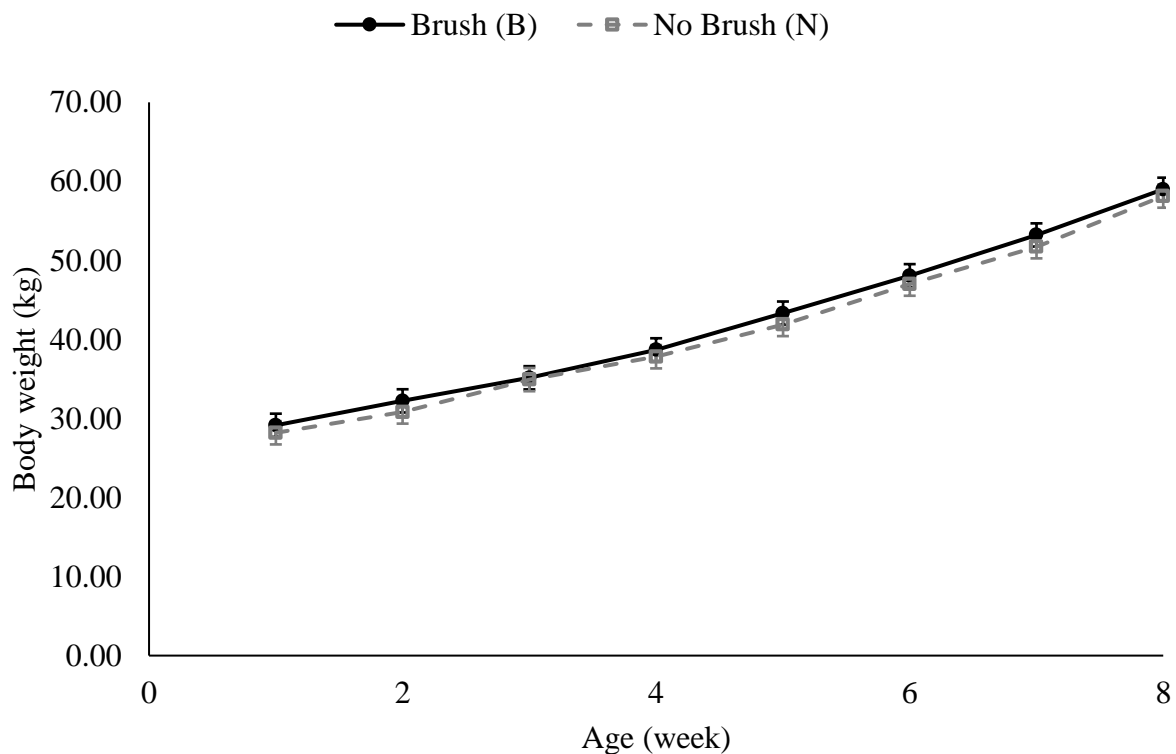


Figure 2. Mean body weight for calves with a brush (B, $n = 10$) and calves without a brush (N, $n = 10$) for 1 to 8 weeks of age. SE for all values was 1.47 kg. There were no differences between treatments ($P > 0.05$).

Table 3. Mean and SE for body weight (BW), average daily gain (ADG), hip height, and wither height for calves with a brush (B, n = 10) and without a brush (N, n = 10) for the pre-weaning period and mean and SE for ADG, hip height change, and wither height change for calves with a brush (B, n = 10) and without a brush (N, n = 10) for the post-weaning period. There were no differences between treatments ($P > 0.05$).

Variable	Brush (B)	No Brush (N)	SE	P-value
Pre-weaning				
BW (kg)	42.4	41.3	1.35	0.59
ADG (kg/d)	0.609	0.611	0.0288	0.96
Hip (cm)	75.9	75.6	0.717	0.85
Wither (cm)	72.4	72.3	0.751	0.91
Post-weaning				
ADG (kg/d)	0.722	0.773	0.0671	0.59
Hip (cm/d)	0.216	0.207	0.0252	0.80
Wither (cm/d)	0.207	0.201	0.0153	0.72

Behavior

In preliminary analysis for 16 calves during the pre-weaning period, calves with a brush (B, n = 8), used the stationary brush for an average of 133.8 s/12 h (Table 4). There were no differences in durations of other recorded behaviors, such as interaction with pen fixtures, self-grooming, and locomotive play, between treatment groups during the pre-weaning period (Table 4).

Table 4. Mean and SE for behavior durations for calves with a brush (B, n = 8) and without a brush (N, n = 8) for the pre-weaning period.

Behavior	Brush (B)	No Brush (N)	SE	P-value
Stationary brush use (s/12 h)	133.8	NA ¹	23.04	NA
Interaction with pen fixtures (s/12 h)	434.9	419.0	98.41	0.90
Self-grooming (s/12 h)	273.2	306.7	55.42	0.67
Locomotive play (s/12 h)	88.2	32.4	41.6	0.33

¹NA = not applicable

In preliminary analysis for 11 calves during the post-weaning period, there was no difference in duration of stationary brush use between treatment groups (Table 5). However, there was a treatment trend for mean mechanical brush use during the post-weaning period. Calves that had brush access pre-weaning (B, n = 6) tended to use the mechanical brush for a longer duration during the post-weaning period than calves that had no brush access pre-weaning (N, n = 5) (Table 5). Also, there was a trend for a treatment by week interaction for mechanical brush use ($P = 0.093$). Calves with a brush pre-weaning (B) tended to use the mechanical brush for a greater duration during week 1 of the post-weaning period than calves that had no prior brush access pre-weaning (N), but there were no differences between treatments during week 2 or 3 of the post-weaning period (Figure 3). Additionally, use of the stationary brush during post-weaning was minimal for calves from both treatment groups (Table 5).

Table 5. Mean and SE for behavior durations for calves with a brush (B, n = 6) and without a brush (N, n = 5).

Behavior	Brush (B)	No Brush (N)	SE	P-value
Mechanical brush use (s/12 h) ¹	372.4	212.3	67.23	0.096
Stationary brush use (s/12 h)	8.91	18.4	6.79	0.33

¹There was a trend ($P < 0.1$).

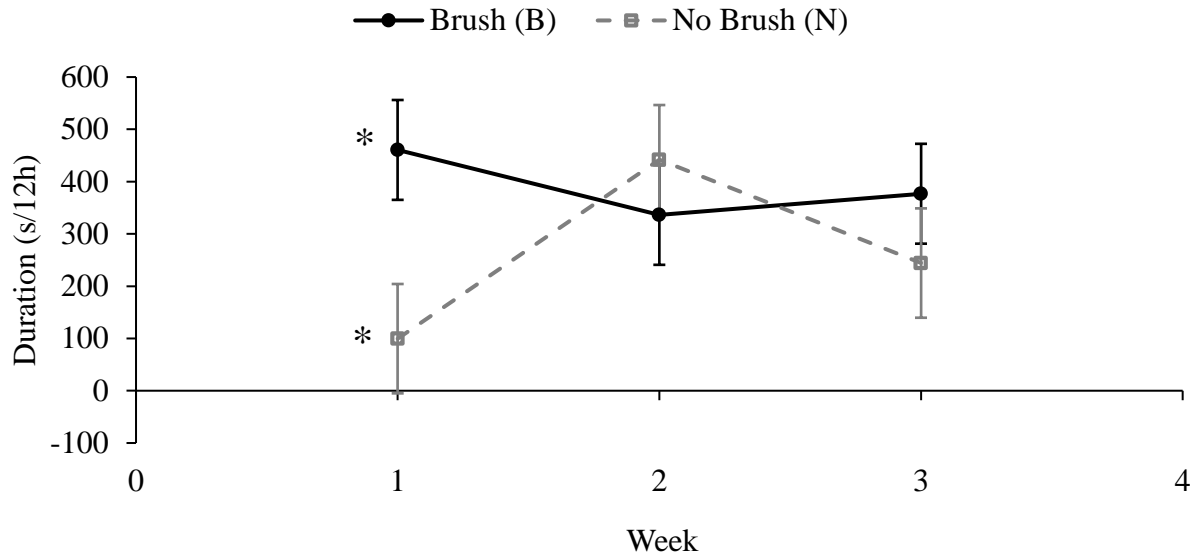


Figure 3. Mean duration for mechanical brush use for weeks 1 through 3 in the post-weaning period by calves with a brush (B, n = 6) and without a brush (N, n = 5). There was a treatment by week trend (* $P = 0.02$).

DISCUSSION

One of the primary objectives of the project was to determine if stationary and mechanical brushes were valuable enrichment tools for dairy calves. While exposure to stationary brushes during the pre-weaning period did not affect calf growth, the calves did utilize the stationary brushes as enrichment devices during the pre-weaning period (133.8 s/12 h). We observed that calves preferred the mechanical brush over the stationary brush during the post-weaning period. This indicates that the mechanical brush may be a more effective and valuable enrichment device. While it is not feasible to have mechanical brushes available for individually housed calves during pre-weaning, it is practical to install one in a group housing pen after calves have been weaned and moved. Additionally, it may be beneficial to consider raising calves in group housing before they are weaned as well, since this would allow producers to reasonably give calves access to the preferred enrichment device and to facilitate social interaction at an earlier age. It is important to note that we observed calves using the mechanical brush for a shorter duration (6.2 min/12 h) than recorded in a past study. For instance, Zobel et. al. (2017) found that pair-housed calves used mechanical brushes for 27.1 min/20 h. We hypothesize that this discrepancy may be a result of the number of calves in the study. In our project, there were 4-6 calves in a pen with the mechanical brush in comparison to the Zobel et. al (2017) study where only 2 calves were in a pen with the brush. The increased competition for the brush with the

greater number of calves in our project may have resulted in this difference in duration of brush use.

We expected to observe other behavioral differences, such as durations of interaction with pen fixtures, self-grooming, and locomotive play, between the treatment groups. However, we did not find any differences in these behaviors during the pre-weaning period between calves with a brush (B) and calves without a brush (N). The behavior results are only our preliminary analyses. Due to time constraints in analyzing the video footage, pre-weaning behavior analyses were only completed for 16/20 calves. It is possible that we did not have the experimental power to pick up significant behavioral differences because we lacked subject numbers. As we continue to analyze additional data, we expect differences to become more pronounced. Also, future research should be conducted to determine if exposure to brushes minimizes stereotypies and other abnormal behaviors, such as tongue rolling, in dairy calves. Even if behaviors, such as interaction with pen fixtures, self-grooming, and locomotive play, are similar between calves with a brush and calves without a brush, determining if brush access limits or prevents abnormal behaviors from occurring would encourage in-field use of such brushes, especially important given the increased use of automated milk feeding systems with group housing.

The second objective of our project was to determine if exposure to a stationary brush during the pre-weaning period affected use of mechanical and stationary brushes during the post-weaning period. While there were not any differences in duration of stationary brush use between the two treatments, calves with prior brush exposure (B) tended to use the mechanical brush for a greater duration during the post-weaning period than calves without prior brush exposure (N). We also observed a treatment by week trend for mechanical brush use post weaning. This indicates that calves exposed to brushes during pre-weaning used the mechanical brush quicker during post-weaning. Essentially, the calves with prior exposure to a brush had less of a learning curve when exposed to the mechanical brush after being weaned. We hypothesize that because calves without a brush (N) had no prior exposure to brushes before they were weaned, it took them longer to learn how to interact with the novel mechanical brush than calves with a brush (B). Thus, the use of brushes pre- and post-weaning may reduce the stress of weaning and changing from individual to group housing.

Again, due to time constraints, post-weaning behavior analyses were only completed for 11/20 calves. As we continue to analyze more data and develop more experimental power, we expect differences to become more prominent. Also, because of the time limitations, the only behaviors recorded and analyzed during the post-weaning period were mechanical brush use, stationary brush use, and other. It would be valuable to conduct additional studies and consider more behaviors.

CONCLUSIONS

Exposure to stationary brushes during the pre-weaning period did not affect calf growth. However, calves utilized the stationary brushes as enrichment devices during the pre-weaning period. The treatment by week trend for mechanical brush use during post-weaning suggests that calves exposed to stationary brushes during the pre-weaning period started to use the mechanical brush quicker during the post-weaning period. Finally, calves preferred the mechanical brush

over the stationary brush during the post-weaning period. We recommend that future research should focus on the effect of environmental enrichment on abnormal behavior duration and frequency in dairy calves.

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